EVALUATING SOURCE TERM FROM POINT SOURCES

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes the methods used to evaluate, calculate, and report the source term for: 1) tritium emissions; 2) vapor emissions; 3) particulate emissions; 4) short-lived progeny; 5) Los Alamos Neutron Science Center (LANSCE) emissions; and 6) non-point (diffuse) emissions.

Scope

This procedure applies to the MAQ staff member assigned to evaluate source terms to be used in the annual Rad-NESHAP report as required by the Rad-NESHAP (40 CFR 61 Subpart H).

In this procedure

This procedure addresses the following major topics:

Signatures

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Approved by: Digitally signed by Terrance L Morgan serialNumber=082197 + cn=Terrance L Morgan, ou=People, ou=Los Alamos National Laboratory, ou=Department of Energy, o=U.S. Government, c=US Date: 2005.06.20 14:50:42 -07'00' Reason: I am approving this document Location: White Rock Terry Morgan, QA Officer	Date: 06/07/05
Work authorized by: Dave Fuehne, Rad-NESHAP Project Leader, Acting MAQ Group Leader	Date: 06/06/05

06/17/05

General information about this procedure

Attachments

This procedure has no attachments.

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	06/16/05	New document developed to describe methodology used to evaluate radioactive emissions exhausted by monitored point sources at LANL and to address DR-436 on downtime calculation.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Meteorology and Air Quality Group (MAQ) personnel performing all or part of this procedure

Training method

The training method for this procedure is **on the job** training and is documented in accordance with the procedure for training (MAQ-024).

Prerequisites

In addition to training to this procedure, the following training is also required before performing this procedure:

- MAQ-RN "Quality Assurance Project Plan for the Rad-NESHAP Compliance Project"
- MAQ-102, "Radioactive Materials Usage Survey for Point Sources"

General information about this procedure, continued

References

The following documents are referenced in this procedure:

- 40 CFR 61, Subpart H (Rad-NESHAP)
- MAQ-QMP, "Quality Management Plan for the Meteorology and Air Quality Group (MAQ)"
- MAQ-RN, "Quality Assurance Project Plan for the Rad-NESHAP Compliance Project"
- MAQ-AIRNET, "Quality Assurance Project Plan for the Radiological Air Sampling Network (AIRNET)"
- MAQ-024, "Personnel Training"
- MAQ-026, "Deficiency Reporting and Correcting"
- MAQ-102, "Radioactive Materials Usage Survey For Point Sources"
- MAQ-106, "Collecting Tritium Stack Bubbler Samples"
- MAQ-109, "Collecting Stack Particulate Filter and Charcoal Cartridge Samples"
- MAQ-112, "Tritium Stack Emission Calculation and Reporting"
- MAQ-114, "Calculating Weekly Particulate And Vapor Radioactive Air Emissions From Sampled Stacks
- MAQ-119, "Evaluating Radioactive Air Emissions From Sampled Stacks"
- MAQ-137, "Evaluating Potential Emissions And Potential Effective Dose Equivalent From Point Sources
- MAQ-501, "Dose Assessment Using CAP88"
- MAQ-506, "Calculation of Air Activation Activity From TA-18"
- MAQ-507, "Preparation of the Annual Rad-NESHAP Report"
- MAQ-601, "Collecting and Processing Stack Air Particulate and Vapor Samples From TA-53"
- MAQ-602, "Tritium Sample Exchange on Monitored Stacks at TA-53" (deleted, but referenced as history)
- MAQ-605, "Gamma Spectroscopy Data Collection For Gaseous Emissions At ES-2 and ES-3"
- MAQ-611, "Analysis And Reporting Of Diffuse Emissions From LANSCE"
- MAQ-612, "Calculating Weekly PVAP Radioactive Air Emissions from Sampled Stacks at TA-53"
- MAQ-613, "Calculating Monthly Tritium Radioactive Air Emissions from Sampled Stacks at TA-53" (referenced as history, not currently used)
- MAQ-614, "Calculating Weekly Gaseous Radioactive Air Emissions from Sampled Stacks at TA-53"
- "Documentation of the 2003 Annual Source Term for Monitored Sources."

Prepare emissions report - background and requirements

Annual source term documentation package

The results of this procedure are reported to Environmental Protection Agency (EPA), Region 6, for compliance with Rad-NESHAP (National Emissions Standards for Hazardous Air Pollutants, Radionuclides) regulations, according to MAQ-507 and 40 CFR 61.94. Emissions calculated with this procedure are modeled with EPA-approved dose assessment software to determine the off-site dose impact from each release, according to procedure MAQ-501. The documentation package accompanying the annual source term is required to meet criteria in the Rad-NESHAP Quality Assurance Project Plan, MAQ-RN. Specifically, this package documents:

- EPA-approved methods used to collect data, in accordance with 40 CFR 61, Appendix B, Method 114.
- annual confirmation of software calculations, as required by MAQ-RN.
- independent peer review of calculation methods, as required by MAQ-RN.

Prepare source term report

To ensure all necessary components are captured in the annual source term documentation, and to address "legacy" issues from previous evaluations, base the write-up for the documentation package on the package from the previous year(s). Follow the steps in the following chapters of this procedure to generate the source term values to include in the report. Submit the report for a calendar year's emissions and dose to EPA on or before June 30 of the following year.

Using the RADAIR database

The RADAIR database has a special section for annual source term evaluation and for evaluating emissions from semi-annual composites. As part of the documentation package, include various screen shots from the database to allow straightforward reproduction of the process.

Requirements for software verification

Requirements in the MAQ QMP for software quality assurance give requirements for using software to generate or manipulate information to be included in the NESHAP report. Although not required for compliance to 40 CFR 61 Subpart H, the recommendations found in DOE-EH-89-9 bulletin, "Technical Software Quality Assurance Issues" and DOE-EH-91-1 bulletin, "Computer Code Quality Assurance" emphasize that 1) the software adequately and correctly performs all intended functions 2) software users should have a thorough understanding of the software they are using.

Specific software verification steps are described in the individual chapters, below.

Prepare emissions report - background and requirements, continued

Requirements for peer review

Summary of requirements: According to requirements in MAQ-RN, data are subject to independent verification. Manually-input data are verified 100%; electronically-transferred data are verified 10%; hand calculations are verified 100%. Software calculations are verified annually, with each step analyzed once.

For each section of the source term report, indicate the type of peer review performed.

Technical review

The technical review process determines whether data meet the data quality objectives (DQOs) specified in MAQ-RN. When the data are ready for annual calculation for the source term, all data will have been evaluated for one of three outcomes: accept, qualify, or reject. This technical review will confirm or modify these data qualifiers. For qualified and rejected data, an explanation must be included in the "Comment" field for the appropriate record in the database.

Data used in the source term calculations may have been qualified as part of previous reviews. Additionally, data used specifically in the source term development may require additional review and evaluation. Investigate data as needed and thoroughly document the actions in the database comment field or in the source term documentation, as appropriate.

Calculating Source Term for Tritium

Overview of tritium sampling and data reporting

Tritium emission sampling is performed using EG&G EL-700 tritium bubblers according to MAQ-106. The results of tritium analyses are used to calculate the weekly emissions of tritium in the form of water vapor (HTO) and elemental gas (HT). These calculations are performed by the RADAIR database, in accordance with procedure MAQ-112. Individual data sets are evaluated according to MAQ-119.

Calculate annual tritium source term

Use the RADAIR database to sum weekly results for each stack and put the final totals for the year in the AnnualSourceTerm table within RADAIR.

Verify software performance

To verify the performance of the RADAIR database to calculate weekly emissions, hand-check one week's calculations for one stack. Use methods from MAQ-112 and appropriate field information and radiological data to ensure the database calculations continue to be correct.

To verify performance of the RADAIR database to calculate annual sums of emissions, download weekly emissions into a spreadsheet, using either the RADAIR database or the web-based reports as a source. Use the spreadsheet to calculate the annual sum of at least one of the tritium stacks.

Check stack flow rates

Inspect the stack flow rates recorded in the RADAIR database for each week. A convenient query for this is "DPF_Flow_Check." Look for anomalies, such as cases where the three-year historical maximum flow changes, and verify that the appropriate change was made.

Other than normal procedures

If equipment failures occurred during the reporting period, estimate emissions by applying downtime correction factors to reported emissions. Any system problems should have been documented on the report forms generated by MAQ-112. Any problems that affect the ability to meet DQOs established in MAQ-RN should have been documented as a deficiency according to MAQ-026.

Calculating Source Term for Vapor Emissions

Overview of vapor sampling and data reporting

Emissions of vapors and highly volatile particulates are measured by adsorption of these sample air stream constituents onto a charcoal canister, according to MAQ-109. These samples are sent to an off-site analytical laboratory for gamma spectroscopy measurements which are used to calculate the weekly emissions of vapors and volatile particulates. These calculations are performed by the RADAIR database, in accordance with procedure MAQ-114. Individual data sets are evaluated according to MAQ-119.

Calculate annual vapor source term

Use the RADAIR database to sum weekly results for each stack and put the final totals for the year in the AnnualSourceTerm table within RADAIR.

Verify software performance

To verify the performance of the RADAIR database to calculate weekly emissions, hand-check one week's calculations for one stack. Use methods from MAQ-114 and appropriate field information and radiological data to ensure the database calculations continue to be correct.

To verify performance of the RADAIR database to calculate annual sums of emissions, sum the weekly emissions from one stack and compare with the database value.

Stack and sample flow rates

Inspect the stack and sample flow rates recorded in the RADAIR database for each week. A convenient query for this is "DPF_Flow_Check." Look for anomalies, such as cases where the three-year historical maximum flow changes, and verify that the appropriate change was made.

Other than normal procedures

If equipment failures occurred during the reporting period, estimate emissions by applying downtime correction factors to reported emissions. Any system problems should have been documented on the report forms generated by MAQ-114. Any problems that affect the ability to meet DQOs established in MAQ-RN should have been documented as a deficiency according to MAQ-026.

Calculating Source Term for Particulate Emissions

Overview of particulate sampling and data reporting

Emissions of particulates are measured by collection on a high-efficiency glass-fiber filter ("paper filter"), according to MAQ-109. These samples are sent to an off-site analytical laboratory for analysis. Each week, gross alpha and gross beta counts are performed on the individual stack sample filters. Additionally, the filters are grouped into three "clumps" of seven filters each, and gamma spectroscopy analysis is performed on these clumps. Additional gamma spectroscopy analyses are performed on individual filters that MAQ staff have identified and not included in clumps. The results are used to calculate the weekly emissions of vapors and volatile particulates. These calculations are performed by the RADAIR database, in accordance with procedure MAQ-114. Individual data sets are evaluated according to MAQ-119.

Twice a year, the weekly samples from each stack are collected into a composite sample for that stack, representing approximately 26 weeks of emissions. This composite sample is cut in half, and destructive radiochemical analyses are performed on one of these composite halves. The remaining half is saved for future analysis. The analytical results from 2 semesters are used to calculate the semester emissions and the final annual sums, which are written to the AnnualSourceTerm table within RADAIR.

Verify software performance

To verify the performance of the RADAIR database to calculate semester emissions, manually recalculate one semester's calculations for one stack, one nuclide. Use methods from MAQ-114 and appropriate field information and radiological data to ensure the database calculations continue to be correct.

To verify performance of the RADAIR database to calculate annual sums of emissions, sum the semester emissions from one stack for one nuclide and compare with the database value.

Blank analyses

When analyzing the composite filters, first develop a set of blank filters for use in correcting the data. To improve statistical performance, all of the following blanks can be used to develop an average blank: the filter matrix blanks (FB or FMB), filter trip blanks (FTB), and the analytical-laboratory-provided matrix blanks (FLMB). Note that if the FLMB samples are to be included in the blank analyses, their "matrix" identifier may need to be renamed "FMB" or "FB" to match the other matrix blanks in order for RADAIR software to run correctly.

Calculating Source Term for Particulate Emissions, continued

Down-time evaluation

The RADAIR down-time for a stack semester composite is calculated by the following formula:

(hrs –down)/((lastday – firstday)*24)

This compares the total hours operational with the total hours between the first and last sampling dates. In situations where there is significant time where the sampler was operational but the stack fan was not, a better formula might be

(hrs-down)/(hrs)

While these formulas should return near-identical results, in certain situations they will differ, depending on stack and sampler operations. For stacks with significant down time levels, evaluate which formula is more appropriate for the given situation. Make any required changes and document the changes in the comment field and in the source term documentation.

Verify flow volumes

Use the RADAIR database to verify the stack flow rate and sample flow rate for each stack, for each week. One convenient query to do this is "DPF_Flow_Check". Inspect the results to look for anomalies, such as times when new three-year historical max flows were used or when sample flow rates changes. Confirm these changes with stack flow reports from the STACKS database and/or sample flow calibration sheets from the pump maintenance program.

Other than normal procedures

If equipment failures occurred during the reporting period, estimate emissions by applying downtime correction factors to reported emissions. Any system problems should have been documented on the report forms generated by MAQ-114. Any problems that affect the ability to meet DQOs established in MAQ-RN should have been documented as a deficiency according to MAQ-026.

Radioactivity detected during stack inspections

In January 2003, the EPA incorporated inspection and maintenance requirements from ANSI N13.1-1999 into the Rad-NESHAP regulations in 40 CFR 61, Subpart H. During these inspections and maintenance activities, as well as during subsequent cleaning activities, radioactive material may be detected on cleaning and inspection equipment. Assume this material to be from particle losses in the sample system and evaluate for radiological constituents. Include any detected radioactive material in the annual source term as a hand-entered item. Calculations and data entry require 100% peer review.

Calculating Source Term for Short-Lived Progeny

Background

Short-lived progeny are those nuclides which are assumed to be present in the air stream but have half-lives so short that they cannot be measured in an off-line analysis. To address this issue, certain nuclides are manually input after the parent nuclide emissions are completely calculated. Typically, these short-lived progeny nuclides are in secular equilibrium with their "parent" nuclide.

The selection of which progeny are included in the source term is based on an evaluation of NCRP-123, as well as professional judgment of MAQ staff. Typically, the practice is to include those nuclides with NCRP-123 deems significant, AND any progeny which MAQ staff feel have a significant impact. For example, the Y-90 progeny of Sr-90 is not included in NCRP-123 as "significant" but Y-90 is included in the source term per MAQ staff evaluation.

Short-term progeny to include

This list of progeny nuclides can change year-to-year. List the nuclides that are included each year in the annual source term memo. In 2004, the following progeny nuclides were included in the source term.

From parent nuclide	Include progeny nuclide(s)
U-238	Th-234, Pa-234m
Ge-68	Ga-68
Sr-90	Y-90
Hg-193	Au-193
Hg-195	Au-195
Hg-197m	Hg-197

Note that prior to 2004, the following parent-progeny chain was included.

U-235	Th-231

Evaluation of NCRP-123 indicated that the Th-231 progeny from U-235 does not have a significant dose impact, so its inclusion was discontinued.

Peer review

Ensure 100% independent verification of the progeny nuclides that were hand-entered by the developer of the source term.

Calculating Source Term for LANSCE Emissions

Background

Stacks at LANSCE are monitored for emissions of radioactive gases, particulates, and vapors. Emissions of tritiated water vapor were monitored through 2001, but discontinued due to the low contribution of tritium to the potential off-site dose. The emissions measurement, calculation, and reporting processes are described in procedures MAQ-605 and MAQ-614.

Particulate and vapor emissions are measured by pulling a sample of stack air through a glass-fiber paper filter and a charcoal absorption canister, respectively. These sample media are then analyzed off-line for gamma-emitting constituents. The sample collection and emissions calculation and reporting processes are described in procedure MAQ-601 and MAQ-612.

Tritium was measured through July 2001. Based on the measured rate of emission from this time period, the emissions can be calculated for current operations. [Procedures MAQ-602 and MAQ-613 (now obsolete) described the sampling and reporting processes.]

Emissions rate calculations

In 2001, the following emissions rates were measured.

- For 53000303: 0.342 curies of HTO emitted per curie of C-11 emitted.
- For 53000702: 1.57E-05 curies of HTO emitted per microamp-hour of beam operations in Line D.

Based on these emission rates or other appropriate methods, calculate the emissions of HTO from the two LANSCE stacks.

Note that relating HTO emissions to C-11 emissions for 53000702 is not appropriate due to the changing levels of gas emissions at this stack since 2001. The activation levels of water should remain the same, so that is the source term used.

Peer review calculations

Have an independent person review 100% of the calculations for tritium emissions.

Calculating Source Term for Diffuse Emissions

Background

Point sources are stacks, ducts, vents, or other forced-air source that emits radionuclides. Other sources, either open-area sources or ventilation sources that are considered standard building HVAC systems, are considered to be non-point sources, called diffuse or fugitive emissions sources. Per the 1995 DOE-EPA Memorandum of Understanding regarding compliance with 40 CFR 61 Subpart H, such diffuse releases shall be included when evaluating Rad-NESHAP compliance activities and comparisons with the 10 millirem annual limit for LANL.

The AIRNET system is the primary means to capture emissions from these diffuse sources. The AIRNET system is described in the plan MAQ-AIRNET and its associated procedures. AIRNET will measure radioactive particulates and tritiated water vapor (HTO). Once the maximum exposed individual is determined, as described in procedure MAQ-507, the AIRNET dose from the most representative station at this location is included in the annual dose totals. However, this dose does not need to be included in this annual source term documentation.

Sources which are not measured by AIRNET need to be evaluated and the information included in this source term documentation.

Calculate

Include results from these processes in the annual source term for emissions:

- supplemental measurements or evaluations for other nuclide diffuse releases which are not measured by AIRNET
- diffuse emissions from TA-18 operations (described in procedure MAQ-506)
- diffuse emission from the LANSCE facility (described in procedure MAQ-611).

Peer review

Calculations of diffuse emissions from TA-18 and from LANSCE should be peer-reviewed as part of their development. Ensure this was done. For this procedure, the only required review is of any hand-entering of these final results into the RADAIR database annual source term listing.

Records Resulting from this Procedure

Records

The following records generated as a result of this procedure are to be submitted as records **within one week of completion** to the records coordinator as part of the Rad-NESHAP annual source term records series:

- Documentation package showing all calculations and verifications